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A New Quantitative Constraint on Poleward Heat Transport in Changing Climates

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Paleotemperatures from several past eras imply that tropical sea surface temperatures have remained nearly constant despite significant changes in global mean temperature. Coupled ocean-atmosphere circulation models have failed to explain this observation, though their global mean response to greenhouse gases is consistent with the paleodata. The models' ability to change meridional heat transport (oceanic or atmospheric) may be less than that of the real Earth. Tropical SSTs could be stabilized because forcing such as enhanced greenhouse warming is compensated by increased transport of heat from the tropics to higher latitudes. Assuming reasonable climate feedbacks, the implied heat flow increases are quite large, peaking at ~ 2×10^{14} Watts for each degree K of global-mean warming. This ratio follows from simple energy-balance considerations.

Our result is consistent with recent numerical experiments of Barron *et al.* in which ocean heat transport was an adjustable parameter. In these experiments, the best fit to mid-Cretaceous temperatures occurred when global-mean warming was about 6 K and peak ocean heat transport was increased by about 10^{15} Watts. Further analysis of such numerical experiments is warranted, especially regarding the partitioning of total poleward heat transport between the atmosphere and ocean.

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